More flights, more seats, more tourists? Evidence from Peru

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Abstract

The aim of this paper is to determine if the increase in the number and capacity of non-stop flights to and from Peru that occurred between 2004 and 2015 affected the number of visitors arriving from its main tourist markets (United States and Europe). Results using a SARIMA-X model show that a 1% increase in the number of available seats on non-stop flights from and to the United States generated a rise in the number of American tourists by 0.36%. In Europe, where only Spain, the Netherlands and France are connected to Peru via non-stop flights, results are heterogeneous. Evidence shows that the increase had no effect on the number of tourists arriving from these countries, but that a higher availability of seats on flights arriving or departing from Spain did have a positive effect in the number of tourists arriving from Italy, Switzerland, and Germany. These findings suggest that expanding existing routes benefits inbound tourism to Peru even though not necessarily from the countries connected via direct air services.

Keywords: Air transport demand; Air connectivity; Inbound tourism; SARIMA-X; Non-stop flights; Tourist markets; Air transport markets

JEL Classification: L83, L93

1. Introduction

The number of international tourists to Peru has increased dramatically in recent years—almost seven times since 1995, more than double the growth in the number of international tourists worldwide. But if almost 96% of them visit the country motivated by cultural reasons (Promperú, 2017) and the number of cultural attractions has practically remained invariant, what can explain an increase of this magnitude? Our hypothesis is that improvements in air connectivity have played a fundamental role in explaining this phenomenon.

Consistently with our hypothesis, the aim of this paper is to determine if the increase in the number and capacity of non-stop flights to and from Peru that occurred between 2004 and 2015 affected the number of visitors arriving from its main tourist markets (United States and Europe). In the case of Europe, we analyze arrivals from the continent as a whole and also from the seven countries from where 82% of the European tourists arrive: France, Spain, the Netherlands, Germany, the United Kingdom, Italy and Switzerland.

This study is relevant from the academic point of view because the role that direct flights play in promoting tourism is not yet fully understood, especially in countries located far from key markets. Tveteras and Roll (2014) and Graham (2013), for example, argue that more non-stop flights promote international arrivals, whereas Duval and Schiff (2011) find that, in the case of New Zealand, a policy to secure non-stop or direct services might not result in a net increase in international arrivals.

From the point of view of policy, studying the effectiveness of strategies aimed at attracting international tourists is relevant because tourism is an activity that generates hard currency and employs large numbers of low-skilled workers, both desirable goals in emerging economies such as those in Latin America. In Peru, for example, tourism contributed to around 10% of Peruvian GDP in 2019 (World Travel Tourism Council, 2020) and created one in four new jobs in the previous five years.

The format of this paper is structured as follows: Section 2 reviews the relevant literature, while Section 3 introduces general information about Peru’s inbound tourism and international air transport. Section 4 describes the data, the model and methodology, and Section 5 presents and discuss the results. Section 6 summarizes the key findings and the policy implications of this study.

2. Literature Review

Air connectivity is a key component of the socioeconomic development of many countries, promoting economic growth (Lee and Chang, 2008; Brida, Cortes-Jimenez and Pulina, 2014) trade, tourism, investment, and innovation (Khan, Qianli, SongBo, Zaman and Zhang, 2017, Dimitriou and Sartzetaki, 2018).

The literature on how non-stop flights affect the arrival of tourists is diverse. Duval and Schiff (2011) find that for the case of New Zealand, the availability of non-stop flights has negligible effects in the arrival of tourists from some markets, which suggests that many of them do not mind connecting at regional hubs. Graham (2013), on the other hand, finds that more direct flights increases international arrivals from the origin to the destination, while Tveteras and Roll (2014) find that the availability of non-stop flights has produced positive effects on the demand for air travel to this country. Culiuc (2014) concludes that the demand for travel is more sensitive to the introduction or elimination of non-stop flights than to changes in the exchange rate; and, according to Koo, Lim and Dobruszkes (2017) in Australia international direct services are exogenous for inbound but endogenous for outbound tourism.

According to Khadaroo and Seetanah (2008), investment in transport infrastructure is key to promoting tourism, since transport costs are one of the main determinants of tourism demand (Lim, 1997, Li, Song and Witt, 2005). On that subject, Prideaux (2000) finds that a larger distance between tourist-generating regions and receptive destinations generates higher transport costs. Indeed, it seems to be very difficult for the most remote destinations to attract more than 1% or 2% of all travelers (McKercher, Chan and Lam, 2008; Liu, Zhang, Zhang, Sun and Qiu, 2019). This is an especially serious problem for many developing countries, which are usually located far from the main airport hubs and tend to be poorly connected by air (Arvis and Shepherd, 2011).

From the travelers' view, transport costs not only encompass air fares but also the time invested in traveling from the point of origin to the desired destination (Gronau, 1970, De Vany, 1974, Small, 2012). The development of connectivity, which involves expanding travel alternatives, has a positive impact on tourist demand because travelers have more options to choose from according to their preferences and budget (Fujii, Im and Mak, 1992). Since the opportunity cost of trips with long hours of travel and complex itineraries with many stops is higher, these are associated with lower air fares (Tveteras and Roll, 2014).

Monetary and time costs are not the only determinants of demand for international tourism. Eilat and Einav (2004) argue that international tourism is explained by the unique production factors that attract tourists to a country (for example, Machu Picchu in Peru), and by the cost of living in that country, measured through the exchange rate between its currency and the currency of the country of origin. Another key variable is competition in air transport. This makes flight fares more affordable and stimulates international tourism activities (Pearce, 1987).

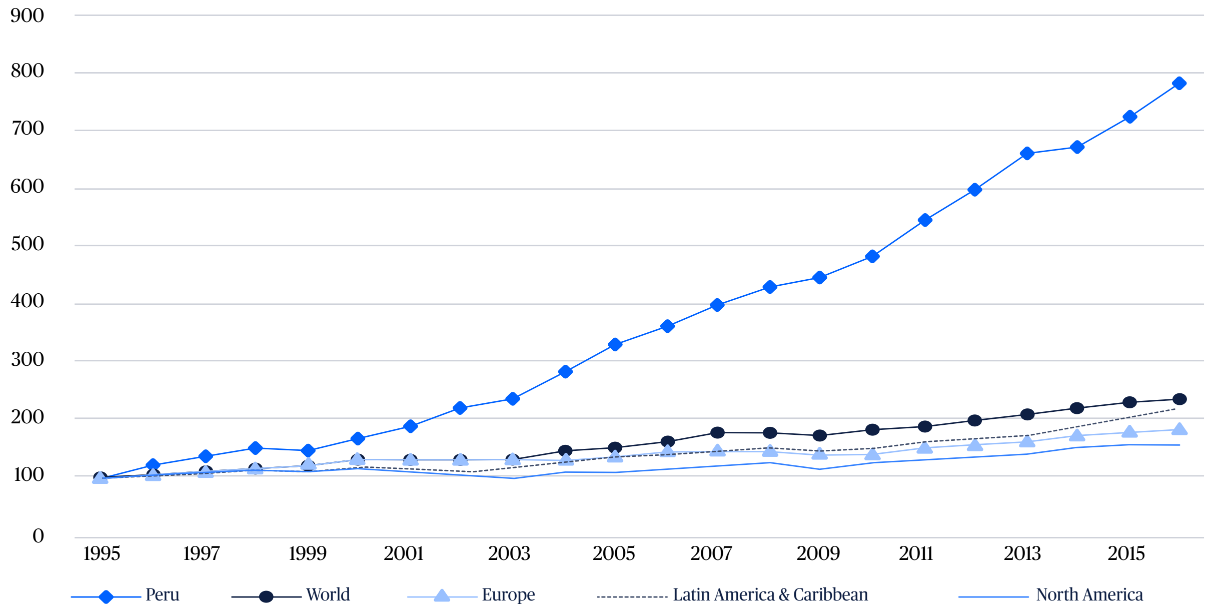
It is worth mentioning that SARIMA models like the one used in this study (an ARIMA model that controls for seasonal variations) have been gaining popularity over the last decade for their capability for providing accurate forecasts of tourist arrivals (Song and Li, 2008; Nanthakumar and Ibrahim, 2010; Alsumairi and Tsui, 2017). Several studies agree that these models allow identifying the effect of the air transport supply on the international tourist demand (Lee, Song and Mjelde, 2008; Yang, Lin and Han, 2010). Others show that seasonality is a characteristic feature of tourist demand, both in quarterly and monthly series (Alleyne, 2006; Tsui, Ozer, Gilbey and Gow, 2014). In these cases, SARIMA models fit the data better (Nanthakumar and Ibrahim, 2010; Akın, 2015; Paladines and Amaiquema, 2020).

3. Peru's inbound tourism and international air transport

3.1. Tourism to Peru

During the last decades, the number of international tourists has been increasing steadily around the world. According to the World Bank (2018), international tourist arrivals rose by 137% between 1995 and 2016 (85% in Europe and 118% in Latin America and the Caribbean). In Peru, however, the number of international tourists rose almost seven times during this period, one of the highest increases in the world. These trends are shown in Figure 1.

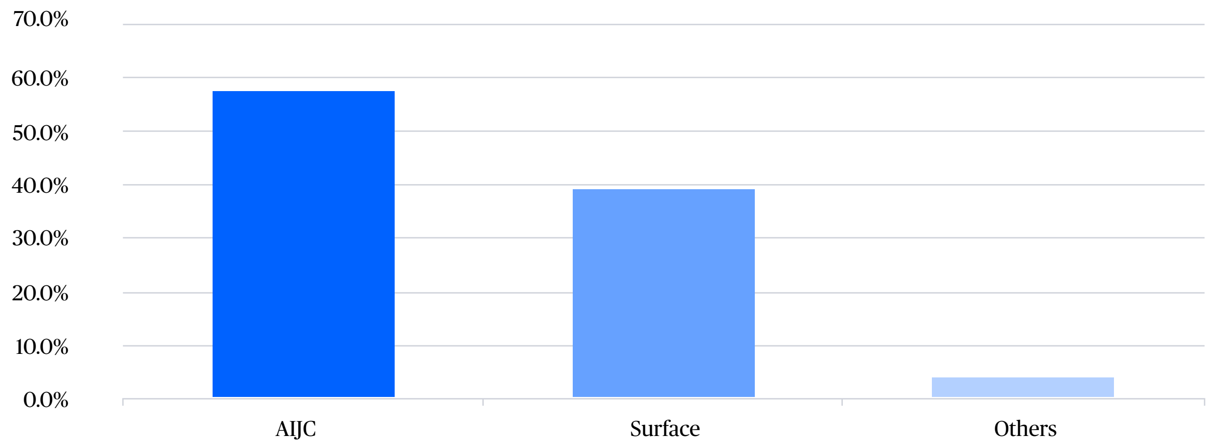
Figure 1. International tourist arrivals (1995 = 100)



Source: World Bank (2018)

According to official figures, around 57% of the international tourists that arrive in Peru do so through Jorge Chávez International Airport (AIJC), the airport that concentrates more than 98% of the international flights that connect Peru with the rest of the world. Around 39% of international tourists arrive by surface and the rest by other means of transport (see Figure 2).

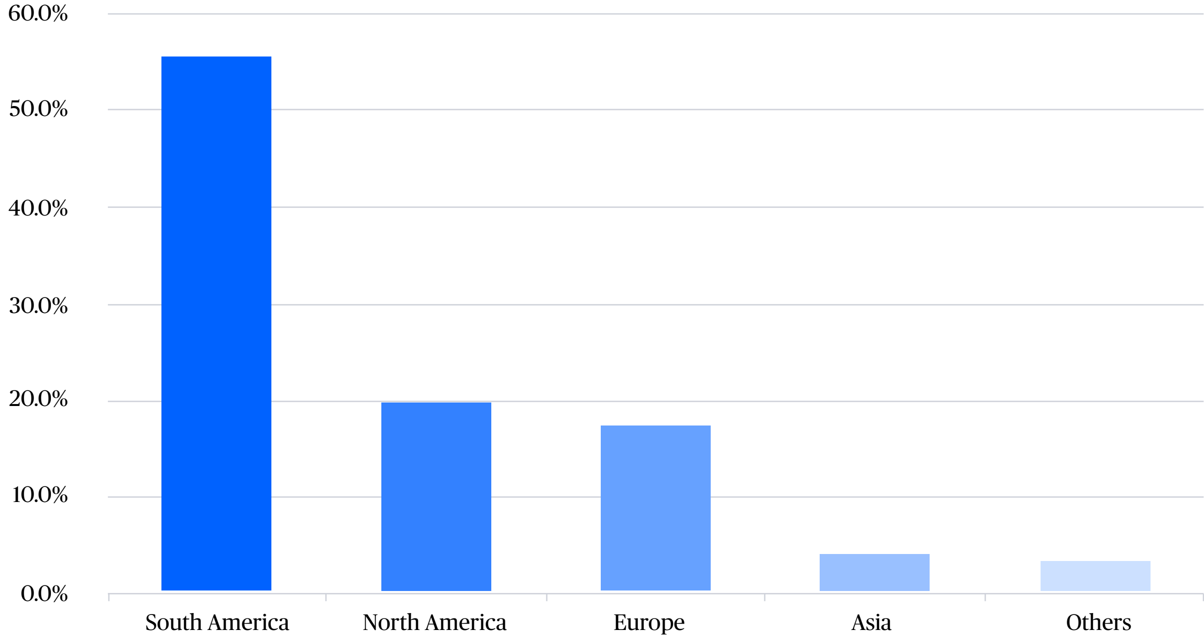
Figure 2. Peru: International tourist arrivals by point of entry (2004 - 2018)



Source: Mincetur (2018)

The main regions of origin of international tourists to Peru are South America (55%), North America (20%), and Europe (17%), as seen in Figure 3. The single largest emitter is neighboring Chile (27%), but almost 80% of visitors from this country arrive by surface.

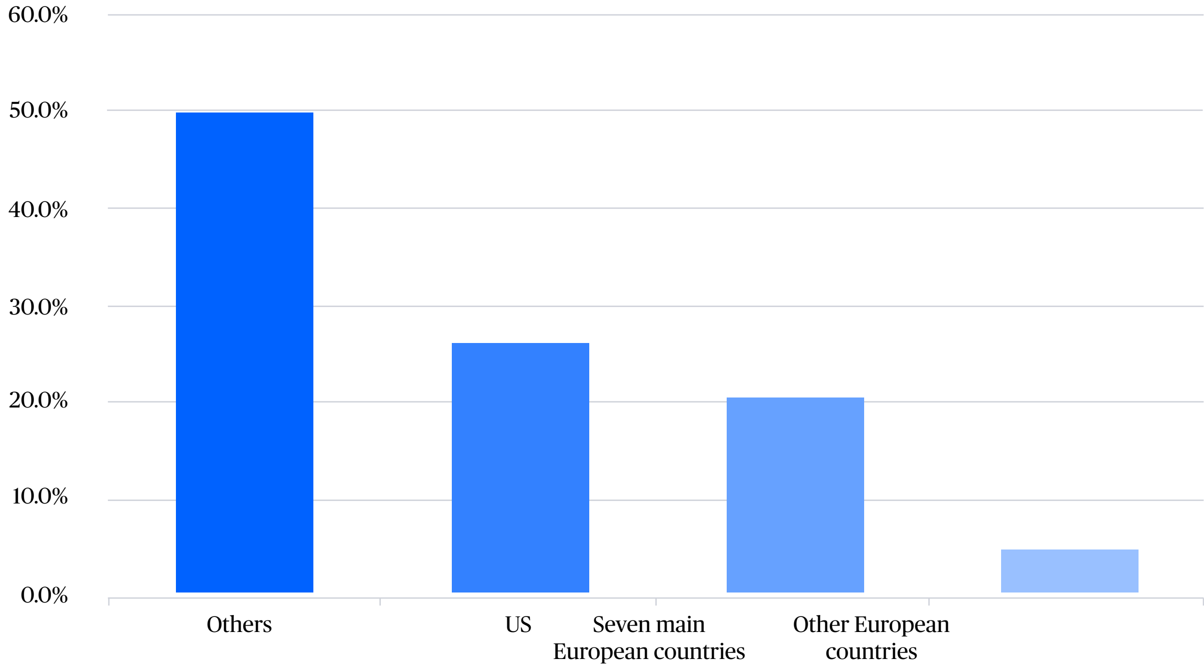
Figure 3. Tourist arrivals composition in Peru



Source: Mincetur (2018)

Among international tourists arriving by air, those from the United States represent 26% and those from Europe 24%. Tourists from France, Spain, the Netherlands, Germany, the United Kingdom, Italy and Switzerland, the seven countries from where 82% of the European tourists arrived in 2015, represent 20% (see Figure 4).

Figure 4. Composition of international tourist arrivals by air



Source: Mincetur (2018)

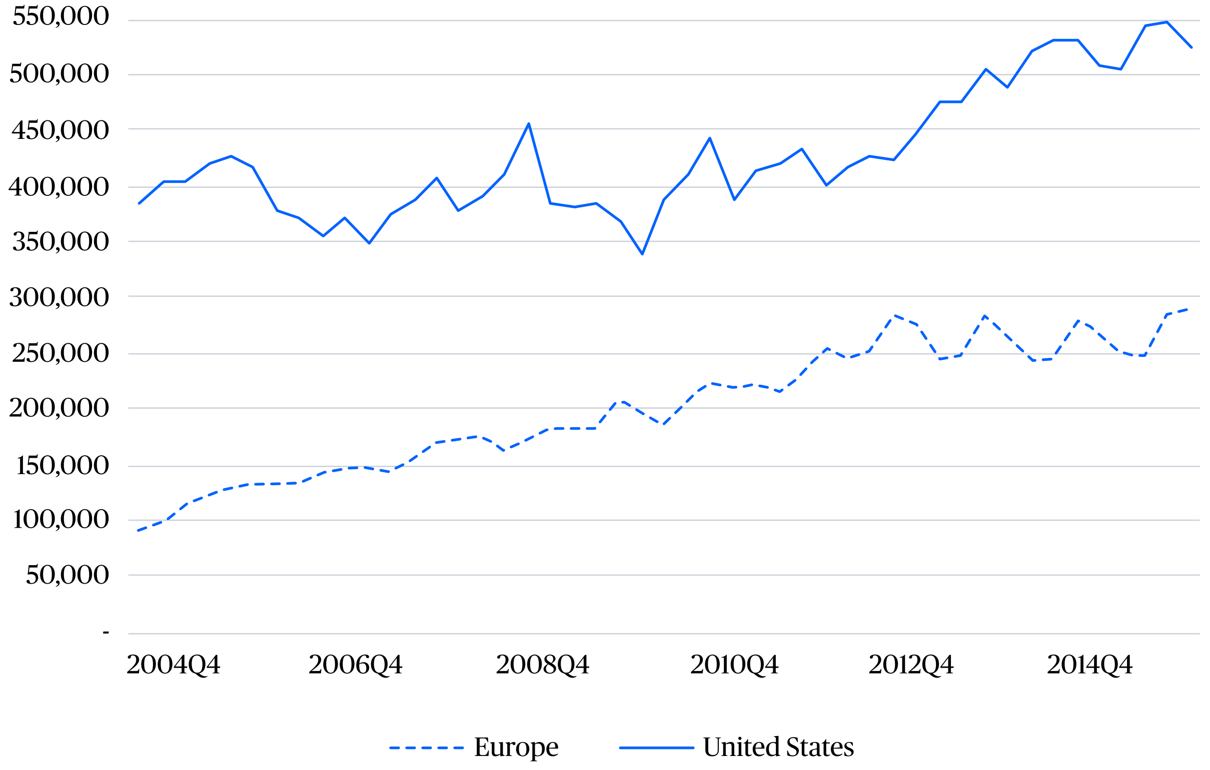
More than 50% of international tourists that visit Peru are between the ages of 15 and 34. Around 61% of them are male and almost 96% cite cultural activities as their main motivation for visiting the country—35% cite visiting Machu Picchu as the main reason (Promperú, 2017).

3.2. Non-stop flights to Peru

In Peru, the number of international routes from and to Peruvian airports increased from 21 in 2001 to 45 in 2016 (nine to the US and three to Europe[1]). In 2018, the AIJC offered 830 international flights per week (LAP, 2018).

As shown in Figure 5, the number of available seats on non-stop flights between the United States and Peru rose by 37% between 2004 and 2015. During the same period, available seats on non-stop flights to and from Europe tripled from less than 100,000 in the second quarter of 2004 to almost 290,000 in the last quarter of 2015 (LAP, 2016). It should be noted that, in addition to the Amsterdam-Lima and Madrid-Lima routes, already existing in 2004, a route between Paris and Lima launched in June 2011. At the end of 2015, these were the only three routes that directly connected Peru and European countries.

Figure 5. Available seats on flights between Peru, the United States and Europe (2004Q2 - 2015Q4)



Source: LAP (2016)

1 Appendix 1 shows the airlines that operated each of the routes during the analysis period.

4. Model and empirical findings

4.1. Data description

Table 1 shows the descriptive statistics and data sources of the variables used in this study. Data on foreign tourist arrivals to Peru were obtained from the Peruvian Ministry of Foreign Trade and Tourism. Data of available seats were provided by Lima Airport Partners (LAP), the current concessionaire of the Jorge Chávez International Airport. Exchange rate series were obtained from the Central Reserve Bank of Peru, GDP per capita figures from the Organization for Economic Co-operation and Development (OECD) and air fuel price data from the United States Energy Information Administration (EIA).

Table 1 shows that among the countries included in the study, the United States is the most important market for Peruvian tourism (87,000 tourists per quarter, on average). Among European countries, the largest number of visitors arrives from Spain (20,000 tourists per quarter, on average), followed by France (13,000 tourists per quarter, on average) and United Kingdom (11,000 tourists per quarter, on average). Table 1 also shows that the air transport market between Europe and Peru is, on average, twice as concentrated as that between the United States and Peru.

Tabla 2: Descomposición del gasto público 1950-2017 y según períodos

Time series variables	Country	Mean	SD	Max	Min	Description
International tourist arrivals	US	87.05	18.18	132.45	57.82	International tourist arrivals in Peru (in thousands)
	FR	13.22	3.82	22.22	6.85	
	ES	19.67	6.19	32.61	7.28	
	NL	4.52	1.26	7.57	2.01	
	DE	9.80	2.47	15.78	4.81	
	UK	10.74	2.32	15.87	6.45	
	IT	7.13	2.02	11.81	3.51	
	CH	3.29	0.59	4.59	2.27	
Available seats (AS)	US	0.43	0.06	0.55	0.34	Quarterly available seats on international flights to and from Peru (in thousands)
	NL	0.06	0.01	0.08	0.04	
	ES	0.13	0.04	0.18	0.05	
	FR[2]	0.01	0.02	0.05	0.00	
Herfindahl - Hirschman Index (HHI)	US	0.13	0.02	0.16	0.09	A concentration index of flights to and from Peru
	Europe	0.29	0.08	0.51	0.21	
Depreciation of the Peruvian currency	US Dollar	0.36	0.71	1.50	-2.17	Depreciation of the Peruvian currency against the US dollar and the Euro
	Euro	-0.32	3.27	6.09	-8.41	
Gross Domestic Product (GDP) per capita	US	0.01	0.01	0.02	-0.02	Quarterly GDP per capita growth
	Europe	0.01	0.01	0.02	-0.03	
	FR	0.01	0.01	0.02	-0.01	
	ES	0.01	0.01	0.04	-0.03	
	NL	0.01	0.01	0.03	-0.04	
	DE	0.01	0.01	0.03	-0.04	
	UK	0.01	0.01	0.02	-0.02	
	IT	0.01	0.01	0.02	-0.02	
	CH	0.01	0.01	0.03	-0.02	
Aviation fuel price		2.96	0.75	4.09	1.66	Aviation fuel average price (US$ per gallon)

Sources: Mincetur (2018), LAP (2016), BCRP (2018), OECD (2020), EIA.

4.2. Model rationale and variables

The aim of this study is to analyze if the increase in the number and capacity of non-stop flights

2 Since the third quarter of 2011.

to and from Peru has had an effect in the number of tourists visiting this country from United States and Europe. Thus, the dependent variable is the number of international tourists arriving in Peru from the United States and Europe. The key explanatory variable is the quarterly number of available seats (AS) on non-stop flights between Peru and these tourism markets. Data ranges from the second quarter of 2004 to the fourth quarter of 2015 (the period in which quarterly data is available). Since the increase in available seats implies improvements in connectivity, and this, in turn, facilitates the arrival of tourists, a positive relationship with the dependent variable is expected.

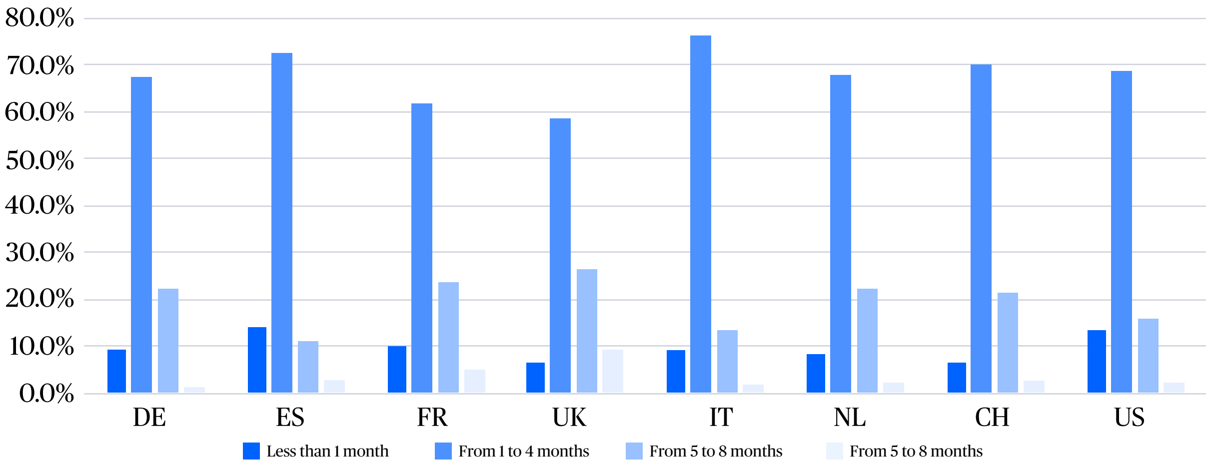
Additionally, four control variables were introduced—all in line with the findings of Lim (1997). The first is the Herfindahl-Hirschman index (HHI), a metric of market concentration. Higher levels of concentration are typically associated with lower levels of rivalry among competitors, and, thus, higher prices for consumers. Therefore, a negative relationship between the HHI and the number of international tourists arriving in Peru is expected.

The second control variable is the price of aviation fuel (FUEL PRICE). Given its high correlation with air fares, it is expected that it will negatively affect the dependent variable. The third control variable is the quarterly depreciation of the Peruvian currency (PEN) against the local currency of the analyzed countries. For the United States, we use the US dollar while for Europe we use three different currencies: the British Pound for the United Kingdom, the Swiss Franc for Switzerland, and the Euro for the rest. Since depreciation of the Peruvian currency reduces the cost of visiting Peru in terms of these currencies, a positive relationship with the dependent variable is expected.

The fourth explanatory variable is the quarterly GDP per capita growth of each emitting country. It is be expected that a growing GDP per capita would increase the disposable income of its nationals and facilitate traveling abroad, so a positive relationship with the dependent variable is be expected.

It should be noted that according to Promperú (2015), most tourists who visit Peru buy their tickets or travel packages (that is, they make the decision to travel) between zero and four months before the start of their trip (see Figure 6). Therefore, the model considers a lag of up to two quarters in the relationship between the growth of GDP per capita of the country of origin and the number of tourists visiting Peru.[3]

Figure 6. Anticipation with which tourists buy their tickets and travel packages to Peru[4]



Source: Promperú (2015)

3 It should be noted that the model does not consider the government's marketing expenditure as a control variable because such information is not available for the entire period of analysis. Nor is there information on the number of European tourists arriving via other countries.

4 US=United States; FR=France; ES=Spain; NL=the Netherlands; DE=Germany; UK=United Kingdom; IT=Italy and CH=Switzerland.

4.3 Methodology and estimation

The SARIMA model is an adaptation of the autoregressive integrated moving average model (ARIMA) developed by Box and Jenkins (1976). The model's aim is to explain seasonal variations of a time series and includes four components: S (seasonal), AR (autoregressive), I integrated, and MA (moving average). It can be interpreted as a combination of two ARIMA models, one of which captures the seasonal pattern observed on a time series. The model is noted as SARIMA (p,d,q) ×(P,D,Q)_S, where the second component explains the seasonal component.

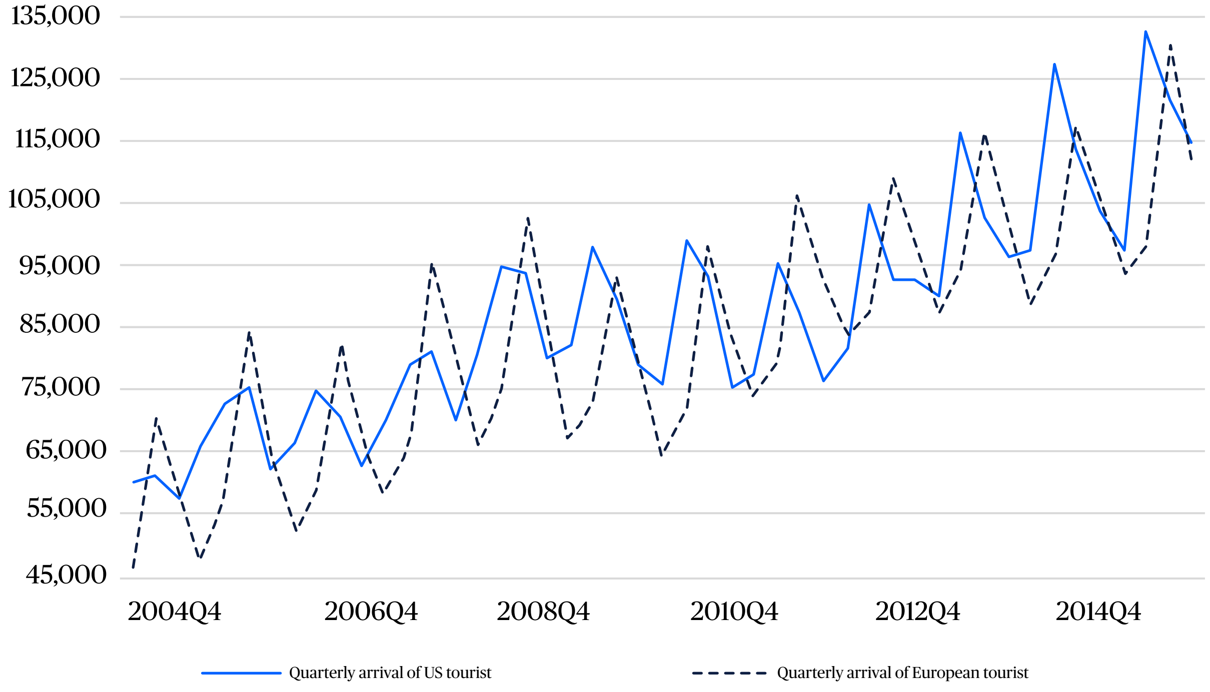
Also, due to the presence of control variables, the estimation will be made through a SARIMA - X model. This variation is a combination between a SARIMA model, and the explanatory variables described in the previous section. The model can be written as follows:

$$\varphi(p)\phi(P)\ \nabla^d\ \nabla^D\ Y_t=\alpha+\theta(q)\Theta(Q)\ \varepsilon_t+\beta X_t$$

Where Y_t is the dependent variable; t is the period in which each of the variables is analyzed; α is the intercept of the equation; $\varphi(p)$ represents the non-seasonal autoregressive process of order p and $\phi(P)$ represents the seasonal autoregressive process of order P. In addition, $\nabla^d\ \nabla^D$ is the level of differentiation made in the series to achieve their respective stationarity, which can be seasonal or non-seasonal. $\theta(q)$ represents the non-seasonal process of moving average of order q and $\Theta(Q)$ represents the seasonal process of moving average of order Q. ε_t is an error term, and X_t is a matrix that contains the stationary control variables.

Figure 7 shows the number of US and European tourists who arrived in Peru between the second quarter of 2004 and the last quarter of 2015. In both cases, positive trends are observed, as well as some peaks between the second and fourth quarters, respectively. Through the Hylleberg-Engle-Granger-Yoo (HEGY) test based on Hylleberg, Engle, Granger and Yoo (1990), the presence of seasonality in each of the series under study was tested. Results show that there is evidence of seasonal unit roots in all cases.

Figure 7. Peru: arrivals of US and European tourists (2004Q2-2015Q4)



Source: Mincetur (2018)

To evaluate the stationarity of the series, the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were applied (some variables were transformed into logarithms in order to stabilize their volatility). Appendix 2 shows the results for both tests by specifying the model with a constant and with a constant plus the trend. Some heterogeneity is observed: several series are stationary, while others are not. However, the non-stationary series, when differentiated, become stationary for both the ADF and PP tests. Likewise, series such as the depreciation of the national currency, the growth rate of GDP per capita of countries such as the United States, France, the Netherlands, Germany, United Kingdom and Switzerland, and other variables, show stationarity without having been previously differentiated.

To identify the order of the AR and MA components of the quarterly series of international tourist arrivals, both the autocorrelation function (ACF) and partial autocorrelation function (PACF) correlograms were used (see Appendix 3). The ACF shows peaks every two quarters for the series of arrivals from United States and Europe, while PACF shows that the process is stationary from the fourth lag, for which the series should be controlled by up to four AR or MA components.

The autocorrelation (ACF) function shows seasonality every two quarters for the series of arrivals from the United States and Europe, while the partial autocorrelation function (PACF) shows that the process is stationary from the fourth lag. The correlograms of these functions are shown in Appendix 3.

Likewise, several specifications of the model were estimated since there is no certainty regarding the structure that better suits the data. These were compared according to the lower values of the Akaike (AIC) and Schwarz (SIC) criteria. Thus, for each dependent variable, a different SARIMA model that follows the following specification was defined:

$$(1-\varphi_a L^x)(1-\phi_b L^w)(1-L)\ln Y_t = \alpha + (1+\theta_c L^z)\ \varepsilon_t$$

Where L is the lag operator.

The first component of the left part of the equation represents the autoregressive process (AR) of the series, while the second component represents the seasonal process (SAR). The third component indicates that the variable must be differentiated in order to be stationary. On the right side of the equation, the component that multiplies the error term considers the moving average (MA) process. In order to confirm that the selected model is adequate, ACF and PACF were applied on the residues to verify if they have white noise characteristics.

5. Results

5.1 Results for the United States and Europe as a whole

Table 2 shows the results of the estimates of the SARIMA-X model applied to the arrival of tourists from the United States and from Europe as a whole. Consistently with the findings of Ozer, Balli and Tsui (2018), we find that the number of available seats is a key explanatory variable for tourist demand. In the first case, there is a positive and significant relationship between the number of available seats on non-stop flights to and from the United States and the number of tourists arriving from that country. An increase of 1% in the number of available seats generates an increase of 0.36% in the number of tourists.

Regarding tourism to Peru from European travelers, the number of available seats appears to have a positive and statistically significant effect, but close to zero. Table 2 shows that an increase of 1% in the number of available seats increases the number of tourists in just 0.02%. We analyze why in the next section.

Table 2 also shows that the tourist demand from Europe increases, on average, by 0.11% when the price of the aviation fuel increases by 1%. This result, although counterintuitive, suggests that the demand of European tourists for Peru is immune to increases in air fares. This probably occurs because the increase registered during the analysis period was relatively small compared to the total cost of the trip. This interpretation, however, must be confirmed with further research.

On the other hand, a positive and significant relationship is observed between the GDP per capita growth lagged two quarters and the demand for tourists. When the European GDP per capita increases by 1 percentage point (pp) during period t, 2% more tourists travel to Peru during the period t+2. This is consistent with the findings of Tveteras and Roll (2014), since the higher the income of the tourists, the lower the relative cost of traveling to Peru, which increases its demand. Consistently with the findings of Culiuc (2014), the sensibility of tourist demand is higher with respect to the air transport supply than with respect to currency depreciation in both cases.

In order to confirm that the selected SARIMA models are adequate, we used the ACF and PACF diagnostics from the residual correlograms and the Ljung-BOX Q-statistics and verified that the residues were distributed as white noise. Additionally, we regressed the residual series with their lags to replicate the Breusch-Godfrey test and concluded that selected SARIMA models did not have serial correlation problems.

Table 2. SARIMA-X estimations of quarterly US and European tourist arrivals (2004Q2 - 2015Q4)

Dependent variable = Quarterly ln(TUR_US/EUROPE)

Variables	US	Europe
ln(AS)	**0.36****	**0.02*****
	(0.164)	**(0.008)**
ln(HHI)	-0.10	-0.06
	(0.182)	(0.116)
ln(Fuel Price)	-0.05	**0.11****
	(0.08)	**(0.048)**
GDP pc growth (-1)	-0.41	-0.21
	(1.262)	(0.935)
GDP pc growth (-2)	1.06	**2.00***
	(1.186)	**(0.985)**
PEN depreciation	0.00	0.00
	(0.003)	(0.002)
AR (1)	0.01	0.00
	(0.141)	(1.568)
AR (2)	-0.03	-0.31
	(0.141)	(1.956)
AR (3)	-0.03	
	(0.151)	
AR (4)	0.95***	
	(0.155)	
SAR (4)		0.11
		(0.206)
SAR (8)		0.83***
		(0.197)
MA (1)	-0.55**	-0.90
	(0.262)	(33.356)
MA (3)		-0.10
		(11.534)
MA (4)	-0.45	
	(1.513)	
SMA (4)	-0.07	0.39
	(0.356)	(0.649)
C	0.01	-0.11**
		(0.045)
R-squared	0.91	0.97
Adj R-squared	0.87	0.96
AIC	-2.729	-2.983
Schwarz criterion	-2.127	-2.381

Note: The variables specified in logarithms (ln) should be interpreted as the growth of the variable. The coefficients with *, ** and *** indicate that the associated explanatory variable is significant as the 0.10, 0.05 and 0.01 significance levels, respectively. The standard errors are reported in parenthesis.

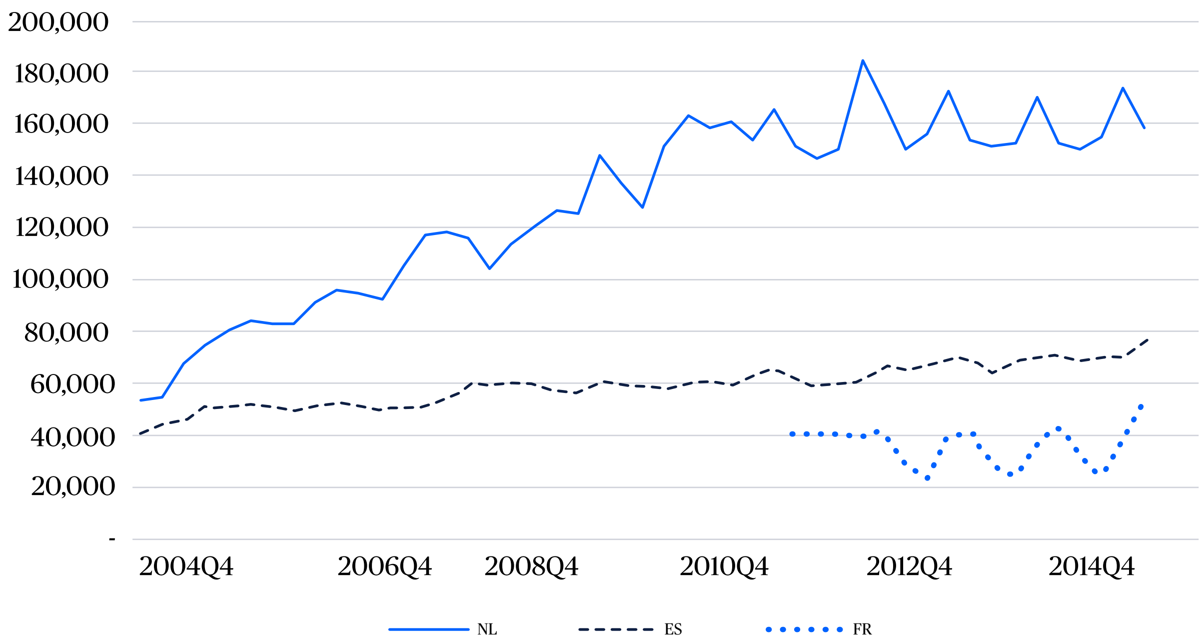
5.2. Results disaggregating the figures for Europe

In order to analyze why the relationship between available seats and the flow of tourists from European countries is so modest, the figures were disaggregated by route and country of origin.

During the analyzed period only three European countries were connected to Peru via non-stop flights: Spain (through Madrid, and during a short period, through Barcelona), the Netherlands (through Amsterdam) and France (through Paris). As shown in Figure 8, although the total number of available seats increased during the period under analysis (as shown in Figure 5), most of the rise was due to the greater availability of seats on frequencies to and from Spain.

Figure 8 also shows that the number of seats available on non-stop flights connecting Peru with the Netherlands and France remained relatively constant during the period of analysis.

Figure 8. Available seats on non-stop flights connecting Peru and European countries (2004Q2 - 2015Q4)



Source: LAP (2016)

5.2.1 Results disaggregating European demand by country

Table 3 shows the results of the estimates of the SARIMA-X model applied separately to the quarterly arrival of tourists from the main seven European markets. It can be seen that a larger availability of seats on non-stop flights had no effect on the number of tourists arriving from the countries where these flights arrive or depart from (the Netherlands, Spain and France). Also, that in the case of non-stop flights to and from Spain, the increased availability of seats did have an effect in the number of tourists arriving from Italy (0.05%) and Switzerland (0.08%). This suggests that expanding existing routes benefits inbound tourism to Peru even though not necessarily from the countries with direct air services.

One counterintuitive result shown in Table 3 is that an increase in the number of available seats on non-stop flights that connect France and Peru led to a statistically significant reduction in the flow of German tourists by 0.03%. This is an unexpected result that implies that the number of German tourists who decide to visit Peru decreases as the frequency of flights between Lima and Paris increases. Further research is required to understand why.

Moreover, it can also be seen that the GDP per capita growth lagged a quarter impacts positively and significantly in the number of tourists. In line with what is observed in Figure 6, an increase of 1 pp in GDP per capita in countries such as Germany, Italy and Switzerland during a quarter generates an increase in the number of tourists from those countries, three months later, by 1.54%, 2.30% and 1.44%, respectively. Likewise, similar to the case when all European tourists and the growth rate of the whole European economy are considered, an increase of 1 pp in the GDP per capita growth in France during quarter t generates an increase in the number of tourists from this country to Peru of 3.49% during quarter t+2.

Table 3. SARIMA-X estimations of quarterly European tourist arrivals to JCIA by country (2004Q2 - 2015Q4)

Dependent variable = Quarterly ln(TUR_COUNTRY)

Variables	FR	ES	NL	DE	IT	UK	CH
ln(AS NL)	-0.06	0.01	-0.11	0.04	0.02	0.01	-0.07
	(0.067)	(0.166)	(0.441)	(0.057)	(0.080)	(0.130)	(0.050)
ln(AS ES)	0.04	0.01	0.05	0.00	**0.05***	0.00	**0.08*****
	(0.031)	(0.073)	(0.162)	(0.020)	**(0.028)**	(0.048)	**(0.026)**
ln(AS FR)	-0.01	-0.01	-0.02	**-0.03***	-0.03	-0.01	-0.01
	(0.016)	(0.035)	(0.050)	**(0.014)**	(0.019)	(0.033)	(0.015)
ln(HHI)	**-0.49****	-0.15	0.12	**-0.41*****	-0.20	-0.49	-0.11
	(0.177)	(0.332)	(0.668)	**(0.112)**	(0.164)	(0.433)	(0.131)
ln(Fuel price)	-0.06	0.06	-0.15	0.00	0.02	0.06	-0.04
	(0.145)	(0.205)	(0.532)	(0.077)	(0.102)	(0.199)	(0.085)
GDP growth (-1)	-1.53	-0.09	0.66	**1.54****	**2.30***	1.78	**1.44****
	(1.585)	(3.039)	(2.915)	**(0.606)**	**(1.279)**	(2.382)	**(0.656)**
GDP growth (-2)	**3.49****	-0.49	2.80	0.13	0.09	-0.21	-0.26
	(1.305)	(2.923)	(3.428)	(0.745)	(1.279)	(2.355)	(0.537)
PEN depreciation	**-0.01****	0.00	-0.15	0.00	0.02	**0.01***	**0.00*****
	(0.003)	(0.005)	(0.532)	(0.003)	(0.102)	**(0.003)**	**(0.002)**
AR (1)	-0.95**	-0.56	0.00	-0.61**	-0.94***	-0.78**	0.19
	(0.352)	(0.685)	(2.585)	(0.239)	(0.280)	(0.377)	(0.253)
AR (2)	-1.41***	-0.66*	-0.74	-0.90***	-0.17	-0.46	-1.04***
	(0.330)	(0.384)	(2.389)	(0.248)	(0.258)	(0.557)	(0.314)
AR (3)	-0.64*		-0.01	-0.35*	-0.59**	-0.49	0.19
	(0.366)		(1.647)	(0.190)	(0.220)	(0.519)	(0.255)
AR (4)	-0.58**	0.15	-0.01	-0.46**	-0.46***		-0.58***
	(0.239)	(0.726)	(1.057)	(0.185)	(0.156)		(0.156)
SAR (4)	0.60	0.92***	0.99***	1.00***	0.99***	0.94***	1.00***
	(0.548)	(0.098)	(0.050)	(0.000)	(0.009)	(0.095)	(0.000)
SAR (8)	0.39						
	(0.538)						
MA (1)			-0.14	-0.40	-0.05		-1.59
			(3.691)	(10.179)	(7.952)		(12.357)
MA (2)	0.00	0.15		0.40	-0.95	-1.00	1.18
	(0.259)	(2.279)		(7.577)	(188.038)	(291.83)	(9.224)
MA (3)	-1.00	-0.97	-0.35	-1.00		0.00	-1.59
	(353.821)	(12.563)	(8.411)	(43.536)		(0.482)	(35.211)
MA (4)		-0.17	-0.51				1.00
		(2.587)	(20.262)				(15.084)
SMA (4)	-0.68*	-0.29	-0.70	-0.99***	-0.41	-0.57	-0.98***
	(0.400)	(0.702)	(1.098)	(0.004)	(0.352)	(0.549)	(0.041)
C	0.03	-0.06	0.20	-0.17	-0.33	-0.03	-0.09
	(0.140)	(0.404)	(1.311)	(0.146)	(0.219)	(0.352)	(0.101)
R-squared	0.99	0.94	0.86	0.98	0.98	0.94	0.95
Adj R-squared	0.98	0.91	0.77	0.96	0.96	0.91	0.92
AIC	-2.504	-2.036	-0.705	-2.517	-1.973	-1.660	-2.644
Schwarz criterion	-1.742	-1.307	0.058	-1.754	-1.250	-0.978	-1.841

Note: The variables specified in logarithms (ln) should be interpreted as the growth of the variable. The coefficients with *, ** and *** indicate that the associated explanatory variable is significant as the 0.10, 0.05 and 0.01 significance levels, respectively. The standard errors are reported in parenthesis.

Results also show that French and German tourists seem to be particularly sensitive to market concentration (a proxy for dearer air fares). Indeed, an increase in 1% of the HHI of the Europe-Peru air transport market (i.e. all routes combined) reduced the arrival of French and

German tourists by 0.49% and 0.41%, respectively. This variable was not statistically significant in the Europe-as-a-whole model.

Likewise, the depreciation of the Peruvian currency generates modest but statistically significant effects in France, the United Kingdom and Switzerland. Other relationships do not seem to be significant with their respective dependent variables.

5.2.2. Results without considering the Amsterdam-Lima route

A probable cause of the modest effect that a larger availability of seats in non-top flights has on the number of European tourists to Peru (especially when compared to the effect it shows on the number of American tourists) is the great heterogeneity found when disaggregating the series of available seats by route. As said before, most of the rise was due to a greater availability of seats on routes to and from Spain. The number of seats available on the Lima-Amsterdam route remained relatively constant during the analyzed period.

Given that the aim of this research is to study the effect that changes in the availability of seats on non-stop flights has on tourism to Peru, we have re-estimated the disaggregated model without considering the available seats of the Amsterdam-Lima route. Results shown in Table 4 confirm the findings shown in Table 3: (i) that an increase in the number of available seats on non-stop flights had no effect on the number of tourists arriving from the countries where these flights arrive or originate from; and (ii) that an increase in the availability of seats on routes connecting Spain and Peru generated an increase in the number of tourists arriving from other European countries. In this case, not only from Italy and Switzerland (as found before) but also from Germany.

Table 4. SARIMA-X estimations of quarterly European tourist arrivals to JCIA by country without Netherlands' AS (2004Q2 - 2015Q4)

Dependent variable = Quarterly ln(TUR_COUNTRY)

Variables	FR	ES	NL	DE	IT	UK	CH
ln(AS ES)	0.01	0.02	-0.02	**0.01***	**0.06*****	-0.01	**0.05*****
	(0.009)	(0.033)	(0.046)	**(0.008)**	**(0.011)**	(0.020)	**(0.013)**
ln(AS FR)	0.00	-0.03	-0.02	-0.02	-0.01	0.01	-0.01
	(0.012)	(0.017)	(0.043)	(0.014)	(0.014)	(0.028)	(0.018)
ln(HHI)	**-0.40*****	-0.17	0.16	**-0.40*****	0.06	-0.31	-0.06
	(0.134)	(0.218)	(0.502)	**(0.122)**	(0.162)	(0.286)	(0.147)
ln(Fuel price)	0.05	0.15	-0.07	-0.04	-0.02	0.05	0.08
	(0.057)	(0.097)	(0.291)	(0.064)	(0.065)	(0.117)	(0.064)
GDP growth (-1)	**-2.15****	0.13	-0.18	**1.51****	**2.64*****	1.60	0.60
	(0.973)	(1.348)	(2.730)	**(0.645)**	**(0.84)**	(2.124)	(0.424)
GDP growth (-2)	**3.53*****	0.59	3.40	0.12	0.39	0.14	0.36
	(1.175)	(1.600)	(2.192)	(0.697)	(0.749)	(2.235)	(0.455)
PEN depreciation	**-0.01****	0.00	-0.01	0.00	0.00	**0.01****	**0.00****
	(0.003)	(0.002)	(0.009)	(0.002)	(0.001)	**(0.002)**	**(0.002)**
AR (1)	-1.07	-0.59	-0.28	-0.59**	0.35	-0.92***	-0.60
	(1.172)	(0.642)	(0.765)	(0.229)	(0.278)	(0.149)	(0.526)
AR (2)	-0.92	-0.12	0.82**	-0.90***	-0.10	-1.00***	-0.01
	(0.808)	(0.573)	(0.388)	(0.238)	(0.241)	(0.024)	(0.394)
AR (3)	-0.74		-0.35	-0.33	-0.32*	-0.91***	-0.41
	(0.609)		(0.446)	(0.212)	(0.171)	(0.147)	(0.33)
AR (4)	-0.41	-0.55	-0.45	-0.47**	-0.46*		-0.47
	(0.625)	(0.383)	(0.730)	(0.190)	(0.246)		(0.278)
SAR (4)	0.22	0.96***	0.99***	1.00***	0.99***	-0.14	1.00***
	(0.380)	(0.051)	(0.033)	(0.000)	(0.007)	(0.379)	(0.000)
SAR (8)	0.76*						
	(0.382)						
MA (1)			-0.11	-0.38	-2.00***		-0.69
			(1.223)	(12.202)	(0.093)		(0.797)
MA (2)	-0.46	-0.61	-1.89***	0.38	1.00***	-0.48*	-0.98
	(1.355)	(0.694)	(0.007)	(7.875)	(0.122)	(0.272)	(0.861)
MA (3)	-0.54	-0.19	0.11	-1.00		-0.44	0.26
	(6.307)	(0.91)	(1.223)	(51.697)		(0.371)	(0.849)
MA (4)		-0.19	0.89***				0.41
		(0.573)	(0.006)				(0.862)
SMA (4)	-0.21	0.99	-0.53	-0.99***	-0.18	-0.60*	-1.00***
	(1.278)	(10.652)	(0.481)	(0.003)	(0.248)	(0.333)	(0.002)
C	-0.06	-0.06	0.10	-0.07*	-0.30***	0.03	-0.23***
	(0.048)	(0.157)	(0.233)	(0.039)	(0.054)	(0.104)	(0.066)
R-squared	0.98	0.95	0.90	0.98	0.99	0.96	0.94
Adj R-squared	0.97	0.93	0.83	0.96	0.98	0.94	0.89
AIC	-2.441	-2.179	-0.881	-2.538	-2.455	-1.959	-2.585
Schwarz criterion	-1.719	-1.489	-0.118	-1.816	-1.773	-1.317	-1.822

Note: The variables specified in logarithms (ln) should be interpreted as the growth of the variable. The coefficients with *, ** and *** indicate that the associated explanatory variable is significant as the 0.10, 0.05 and 0.01 significance levels, respectively. The standard errors are reported in parenthesis.

5.3. Endogeneity analysis

Even though Koo, Lim, and Dobruszkes (2017) find that in Australia inbound tourist arrivals is an exogenous variable, it is possible that endogeneity is present in this case due to the occurrence of simultaneous changes in tourist arrivals and available seats. To test if this is the case, we need to find a valid instrumental variable that complies with two important conditions (Villas-Boas and Winer, 1999): (i) high correlation with the suspected endogenous regressor (available seats), and (ii) no correlation with the error term of the regression of interest.

Consistently with Wright (1928), we identify the demand curve using supply shocks; and, similar to Stern (1996), Mumbower, Garrow and Higgins (2014) and Tsui, Tan and Shi, (2016), we use HHI (as previously defined) as an instrumental variable for available seats[5].

HHI satisfies both conditions stated above. On the one hand, as Table 5 shows, there is a significant and negative relationship between market concentration (HHI) and available seats. On the other hand, changes in market concentration do not occur as a consequence of unobservable factors related to tourism demand (such as the preferences of tourists or the decision to travel to Peru). For this reason, no correlation between HHI and the regression error should be expected. Any change in tourist arrivals caused by HHI should only occur through changes in the number of available seats (the suspected endogenous regressor). Therefore, the HHI represents a good instrumental variable.

Table 5. First stage estimations of market concentration and available seats (2004Q2 - 2015Q4)

Dependent variable = Quarterly ln (AS_US/EUROPE)

Variables	AS US	AS Europe
ln(HHI)	**-0.56*****	**-0.33*****
	(0.094)	**(0.099)**
AR (1)	0.75	
	(2.188)	
AR (3)	-0.40	
	(2.184)	
AR (4)	0.15	
	(1.259)	
MA (1)	-1.10	-0.03
	(42.382)	(0.143)
MA (2)		-0.62***
		(0.129)
MA (3)	0.37	-0.26*
	(49.398)	(0.147)
MA (4)	-0.26	0.57***
	(44.760)	(0.184)
C	0.00**	0.02***
	(0.002)	(0.005)
R-squared	0.50	0.52
Adj R-squared	0.40	0.45
AIC	-3.007	-3.032
Schwarz criterion	-2.649	-2.754

Note: The variables specified in logarithms (ln) should be interpreted as the growth of the variable. The coefficients with *, ** and *** indicate that the associated explanatory variable is significant as the 0.10, 0.05 and 0.01 significance levels, respectively. The standard errors are reported in parenthesis.

Tables 6 present the second stage of the two stage least square (2SLS) regression of tourist arrivals and available seats using HHI as an instrumental variable. It can be seen that results are very similar to those shown in Table 2: the effect is positive and significant for the United States, and statistically significant but close to zero for the European case. This implies that results are robust. If endogeneity is present, its effects are small.

5 According to the existing literature (Stern, 1996; Mumbower, Garrow and Higgins, 2014; Tsui, Tan and Shi, 2016), it is valid to use HHI as an instrumental variable even if it was used as control variable before. As shown in Table 2, there is no evidence that HHI affects the arrival of tourists from Europe as a whole, which suggests, as assumed, that the relationship between both variables is indirect.

Table 6. Second stage estimations of quarterly US and European tourist arrivals to JCIA using HHI as an instrument (2004Q2 - 2015Q4)[6]

Dependent variable = Quarterly ln (TUR_US/EUROPE)

Variables	US	Europe
ln(AS)	**0.25****	**0.02*****
	(0.11)	**(0.004)**
ln(Fuel Price)	-0.08	**0.11****
	(0.113)	**(0.041)**
GDP growth (-1)	0.12	-0.37
	(1.379)	(0.92)
GDP growth (-2)	0.7	**2.27****
	(1.212)	**(0.866)**
PEN depreciation	**-0.01***	**0.00***
	(0.004)	**(0.001)**
AR (1)	-0.15	-0.16
	(0.272)	(0.384)
AR (2)	-0.17	-0.74
	(0.282)	(0.437)
AR (3)	-0.17	
	(0.257)	
AR (4)	0.82**	
	(0.299)	
SAR (4)		0.40
		(0.249)
SAR (8)		0.58**
		(0.234)
MA (1)	-0.42	-0.56
	(0.545)	(3.376)
MA (3)		-0.44
		(10.824)
MA (4)	0.67	
	(0.521)	
SMA (4)	-0.66	-0.45
	(0.431)	(0.327)
C	0.01	-0.10***
	(0.008)	(0.023)
R-squared	0.92	0.97
Adj R-squared	0.88	0.96
AIC	-2.654	-3.186
Schwarz criterion	-2.069	-2.624

Note: The variables specified in logarithms (ln) should be interpreted as the growth of the variable. The coefficients with *, ** and *** indicate that the associated explanatory variable is significant as the 0.10, 0.05 and 0.01 significance levels, respectively. The standard errors are reported in parenthesis.

Unfortunately, it has not been possible to find a completely exogenous variable to introduce as instrument in the disaggregated model (each European country analyzed individually), since market concentration has not changed in the Amsterdam-Lima and Paris-Lima routes (during the period of analysis KLM and Air France were the two only airlines offering flights in each of these routes, respectively,). For this reason, the 2SLS estimation is not possible in the disaggregated model.

6 The SARIMA model used in this estimation is the same as the one shown in Table 2. The only difference is that in this estimation the variable AS is treated as an endogenous regressor. Therefore, any differences between the estimates presented in tables 6 and 2 are solely attributable to the change in the characterization of the model. This allows us to conclude that the causality found is robust.

6. Conclusions

The aim of this paper is to determine if the increase in the number and capacity of non-stop flights to and from Peru that occurred between 2004 and 2015 affected the number of visitors arriving from its main tourist markets (the United States and Europe). In the case of Europe, we analyzed tourist arrival from the continent as a whole as well as the individual cases of the seven most important countries for Peruvian tourism: France, Spain, the Netherlands, Germany, the United Kingdom, Italy and Switzerland. To do so, we used a SARIMA-X model with five explanatory variables.

Consistently with the findings of other authors, we find that the number of available seats is a key explanatory variable for tourist demand. In the case of the United States, we find that an increase of 1% in the number of available seats on non-stop flights generates an increase of 0.36% in the number of tourists. However, in the case of the European market, this effect is positive and statistically significant but close to zero (just 0.02%).

To understand why this effect is so modest, we disaggregated the European market by country and route. In doing so, we find that: (i) a larger availability of seats on non-stop flights had no effect on the number of tourists arriving from the countries where these flights arrive or depart from (the Netherlands, Spain and France); and (ii) that in the case of non-stop flights to and from Spain, the increased availability of seats did have an effect in the number of tourists arriving from Italy, Switzerland and Germany.

The findings of this study suggest that expanding existing routes benefits inbound tourism to Peru even though not necessarily from the countries with direct air services. Given that the role that non-stop air services play in promoting tourism to long-haul destinations is not yet fully understood, we consider this finding relevant.

The main policy implication of this study is that, contrary to what many authorities and tourism planners seem to think, opening new routes is not a necessary step to attract more tourists from certain destinations–which is in line with the findings of Duval and Schiff (2011). Expanding existing ones can be just as useful. However, complementary strategies such as higher spending on marketing and promotion should be explored in countries where a larger availability of seats has led to a larger number of tourists.

Two of the findings from this study deserve further study. First, the fact that the demand of European tourists for Peru seems to be immune to increases in air fares (we find that demand increases in 0.11% on average when the price of the aviation fuel increases by 1%). Our hypothesis is that the increase in air fares registered during the analysis period was relatively small compared to the total cost of the trip.

Second, that an increase in the availability of seats in the Paris-Lima route leads to a reduction in the number of German tourists by 0.03%. This is a counterintuitive finding. Our hypothesis is that given the volatility of the series of available seats on this route, some increases in the flow of German tourists may coincide with reductions in the number of seats. In such situations, German tourists may reach Peru via Spain, as the findings shown in Table 4 suggest.

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Appendix 1. Non-stop routes between Peru, the United States and European countries (2004-2015)

Dependent variable = Quarterly ln (TUR_US/EUROPE)

Region	Country	City	Period	Airline
North America	United States	Atlanta	2004-2015	Delta
		Dallas	2004-2006	American Airlines
		Fort Lauderdale	2007-2015	Spirit Airlines
			2013-2015	Jet Blue
		Houston	2004-2011	Continental Airlines
			2011-2015	United Airlines
		Los Angeles	2004-2015	Lan Chile / Lan Peru
		Miami	2004-2008	Copa Airlines
			2004-2015	American Airlines
			2004-2015	Lan Peru
			2010-2015	Taca Perú
		New York	2004-2015	Lan Chile
		Newark	2004-2011	Continental Airlines
			2011-2015	United Airlines
		Orlando	2015	Lan Perú
Europe	France	Paris	2011-2015	Air France
	The Netherlands	Amsterdam	2004-2015	KLM
	Spain	Barcelona	2009-2010*	Air Madrid
		Madrid	2004-2009	Air Madrid
			2004-2009	Air Plus
			2010-2015	Air Europa
			2004-2015	Iberia
			2007-2015	Lan Peru

*Only two months: Since December 2009 to January 2010.

Source: LAP (2018)

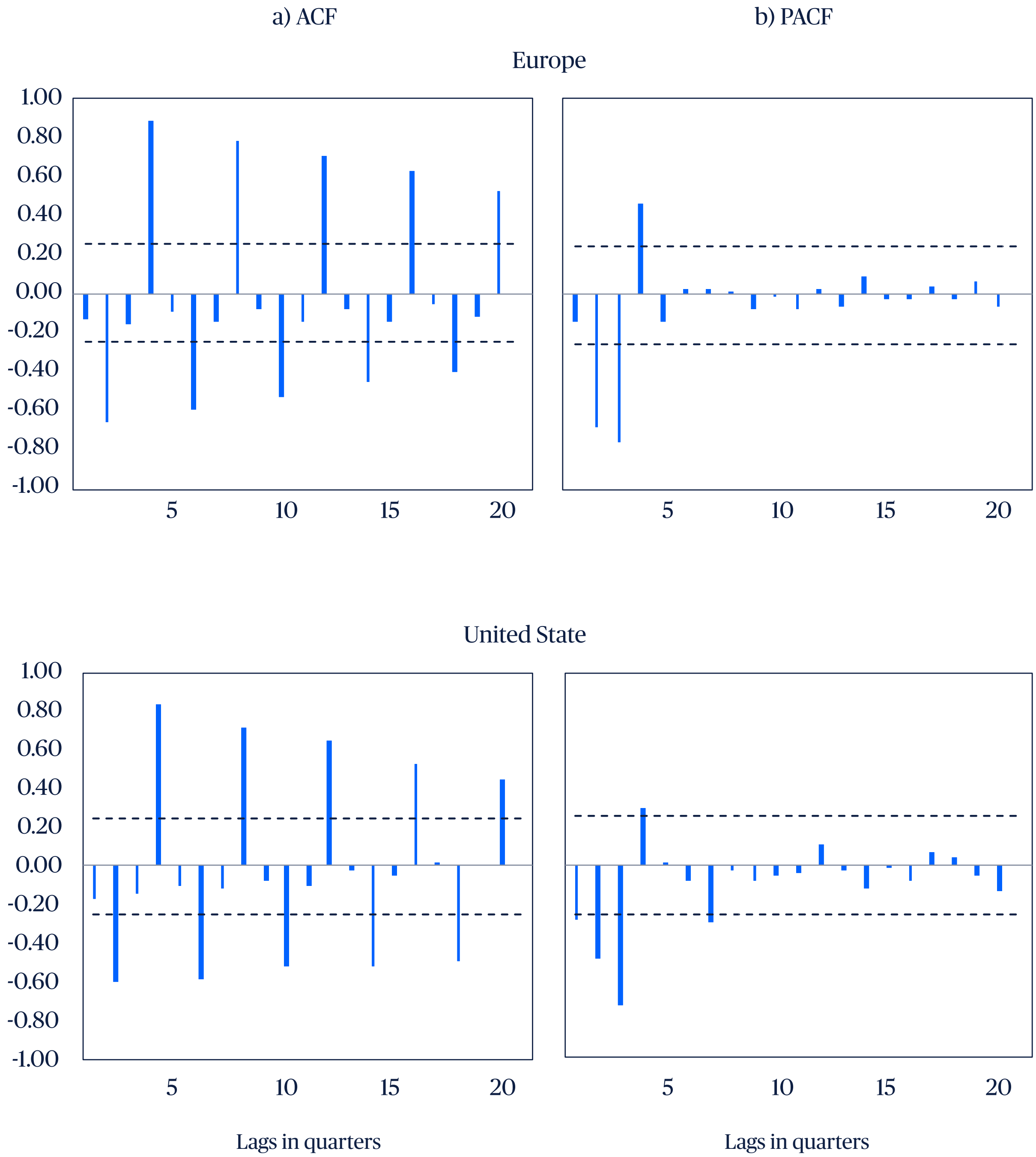
Appendix 2. ADF and PP unit root tests (2004Q2-2015Q4)

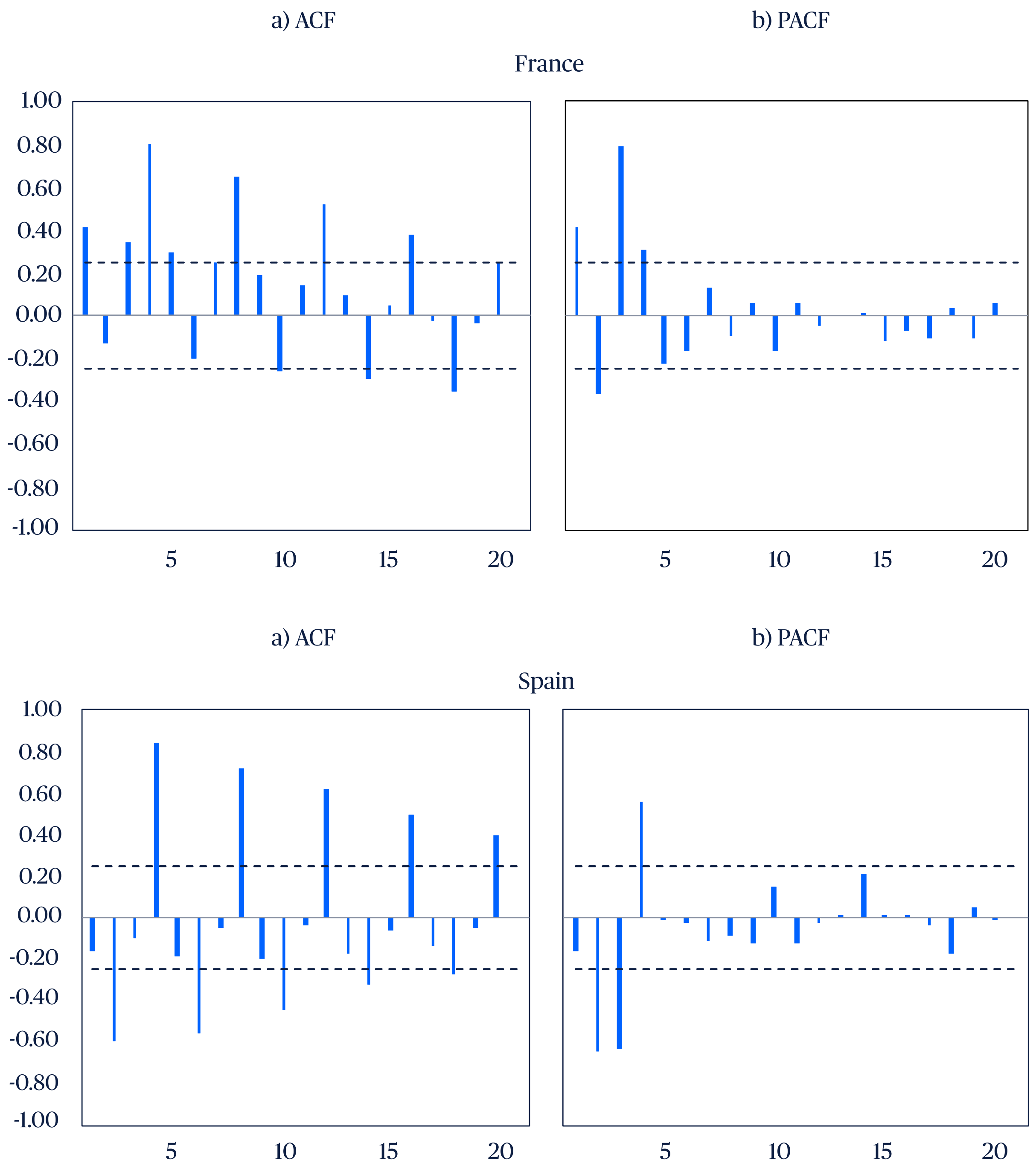
Variable	Test	T - Statistic			
		Constant		Constant and trend	
		ln(x)	diff ln(x)	ln(x)	diff ln(x)
Ln(TUR_US)	ADF	-0.11	-3.22**	-2.41	-3.13
	PP	-2.54	-17.37***	-5.74***	-16.98***
Ln(TUR_EUR)	ADF	-0.62	-2.79*	-2.82	-2.64
	PP	-4.08***	-13.47***	-8.63***	-13.13***
Ln(TUR_FR)	ADF	-0.93	-3.62**	-5.21***	-3.66**
	PP	-4.79***	-11.24***	-10.3***	-10.97***
Ln(TUR_ES)	ADF	-1.01	-5.46***	-1.30	-5.52***
	PP	-3.54**	-18.34***	-15.46***	-17.94***
Ln(TUR_NL)	ADF	-1.74	-15.31***	-2.57	-15.16***
	PP	-4.10***	-10.85***	-4.92***	-10.28***
Ln(TUR_DE)	ADF	-0.87	-25.59***	-3.96**	-25.41***
	PP	-4.18***	-27.68***	-18.46***	-27.21***
Ln(TUR _UK)	ADF	-2.25	-3.19**	-2.22	-3.12
	PP	-6.79***	-13.98***	-7.01***	-14.08***
Ln(TUR _IT)	ADF	-0.47	-4.64***	-2.91	-4.55***
	PP	-5.92***	-19.01***	-17.68***	-18.94***
Ln(TUR_CH)	ADF	-0.07	-14.38***	-1.75	-14.23***
	PP	-3.30**	-23.51***	-6.71***	-24.94***
Ln(AS_US)	ADF	-1.31	-3.44**	-2.69	-3.84**
	PP	-1.09	-9.29***	-2.55	-17.44***
Ln(AS_EUR)	ADF	-2.95**	-8.72***	-2.27	-6.19***
	PP	-3.19**	-7.30***	-3.51*	-10.25***
Ln(AS_NL)	ADF	-2.10	-5.34***	-4.73***	-5.26***
	PP	-2.11	-8.83***	-4.73***	-8.51***
Ln(AS_ES)	ADF	-3.87***	-7.04***	-1.78	-7.10***
	PP	-4.34***	-6.96***	-2.63	-12.10***
Ln(AS_FR)	ADF	-0.68	-6.65***	-2.17	-6.63***
	PP	-0.65	-6.66***	-2.17	-6.64***
Ln(HHI_US)	ADF	1.39	-3.98***	-3.09	-4.88***
	PP	-1.43	-11.07***	-3.24*	-13.80***
Ln(HHI_EUR)	ADF	-2.41	-5.49***	-4.19***	-5.69***
	PP	-2.49	-5.36***	-3.02	-5.68***
Ln(PRICES)	ADF	-2.36	-7.99***	-0.82	-8.70***
	PP	-2.24	-5.84***	-1.69	-7.87***
DEP_DOL	ADF	-4.14***	-6.27***	-4.80***	-6.28***
	PP	-3.40**	-13.03***	-3.65**	-13.53***
DEP_EUR	ADF	-4.90***	-8.25***	-4.84***	-8.15***
	PP	-4.66***	-13.98***	-4.58***	-13.83***
GDP_pc_g_US	ADF	-3.87***	-9.51***	-3.87**	-9.40***
	PP	-3.87***	-10.59***	-3.89**	-10.45***
GDP_pc _g_EUR	ADF	-3.12**	-7.22***	-3.11	-7.13***
	PP	-3.12**	-7.76***	-3.11	-7.64***
GDP_pc _g_FR	ADF	-3.11**	-7.49***	-3.23*	-7.40***
	PP	-3.11**	-7.65***	-3.23*	-7.55***
GDP_pc _g_ES	ADF	-2.07	-5.65***	-1.92	-5.61***
	PP	-2.10	-6.28***	-1.95	-6.60***
GDP_pc _g_NL	ADF	-3.57**	-8.78***	-3.83**	-8.67***
	PP	-3.53**	-10.72***	-3.83**	-10.54***

Variable	Test	T - Statistic			
		Constant		Constant and trend	
		ln(x)	diff ln(x)	ln(x)	diff ln(x)
GDP_pc _g_DE	ADF	-4.58***	-9.81***	-4.53***	-9.69***
	PP	-4.61***	-10.49***	-4.57***	-10.36***
GDP_pc _g_UK	ADF	-5.51***	-5.60***	-5.43***	-5.53***
	PP	-3.45**	-8.13***	-3.44*	-7.96***
GDP_pc _g_IT	ADF	-2.70*	-6.96***	-2.65	-6.89***
	PP	-2.87*	-7.11***	-2.83	-7.03***
GDP_pc _g_CH	ADF	-3.02**	-7.43***	-3.20*	-7.36***
	PP	-3.04**	-9.14***	-3.13	-9.33***

Note: diff denotes first-order differencing. The t-statistics with *, ** and *** indicate that the hypothesis of existence of a unit root is false with at a level of significance of 0.10, 0.05 and 0.01, respectively.

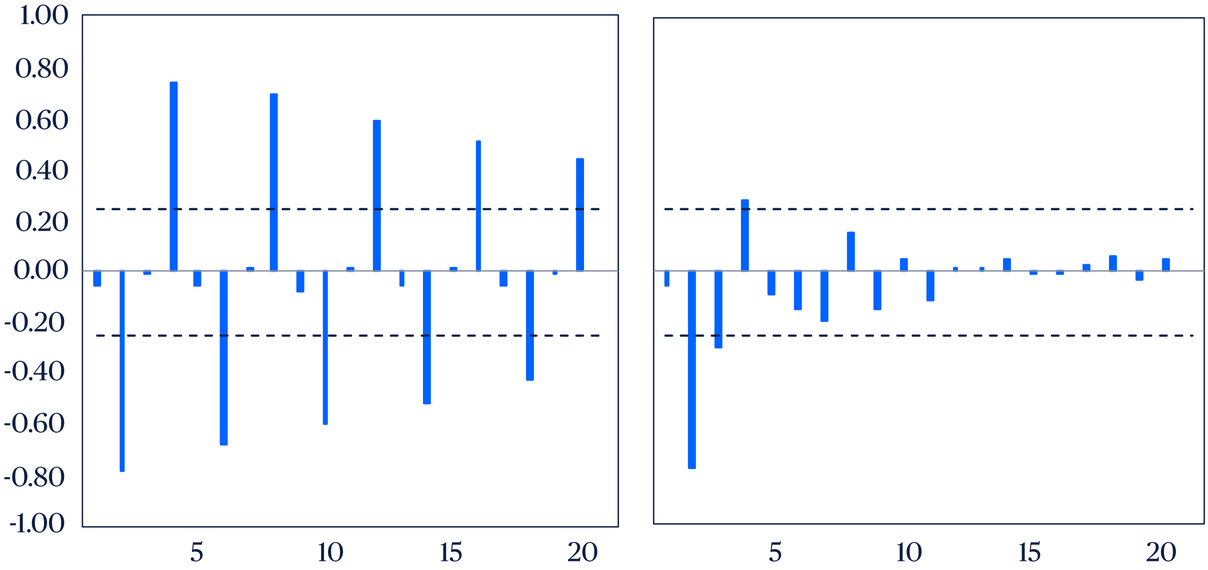
Appendix 3. Correlograms of tourist arrivals to Peru (2004Q2-2015Q4)




a) ACF
b) PACF
France
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
5
10
15
20
a) ACF
b) PACF
Spain
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
5
10
15
20

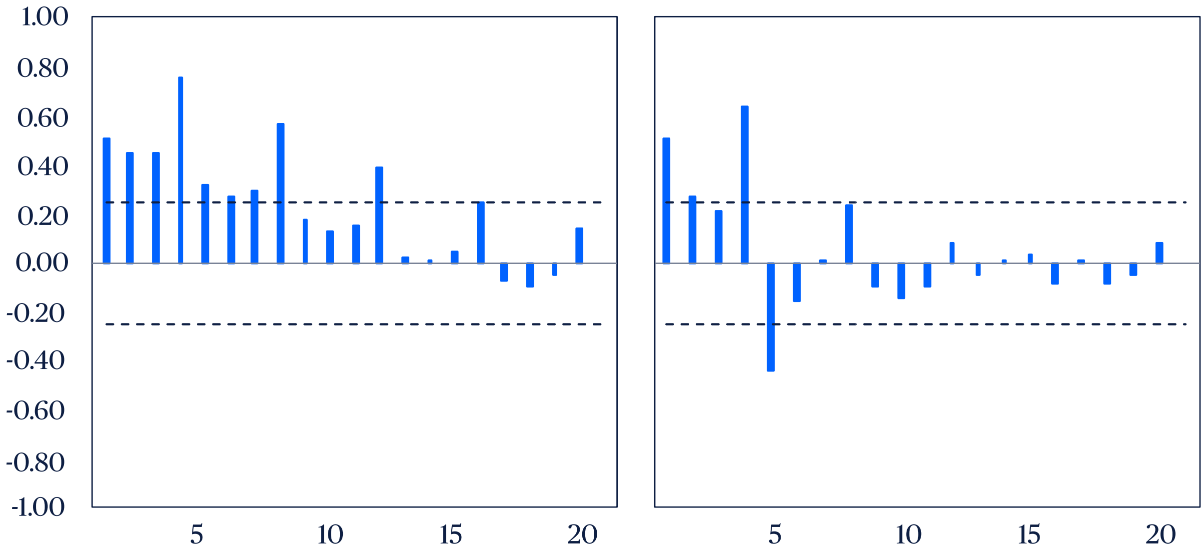
a) ACF b) PACF

Netherlands



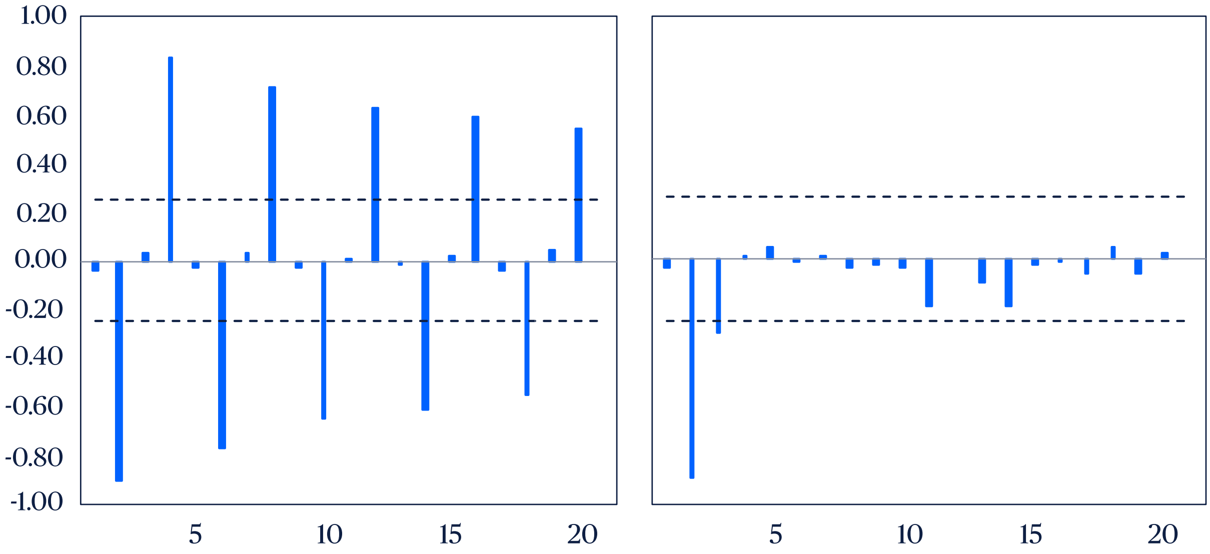
a) ACF b) PACF

Germany



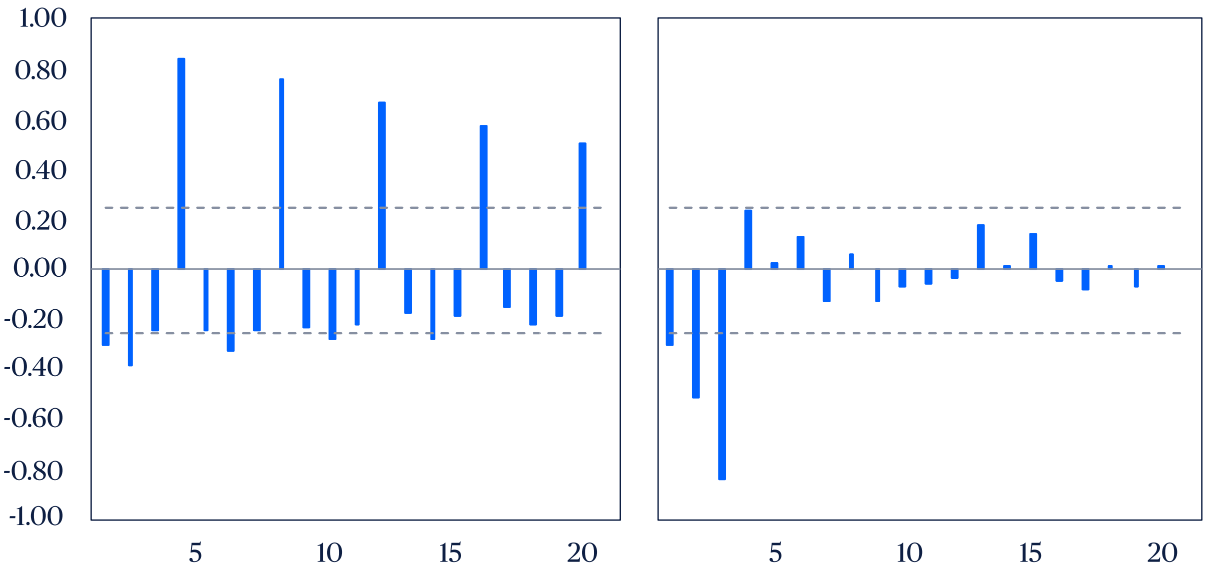
a) ACF b) PACF

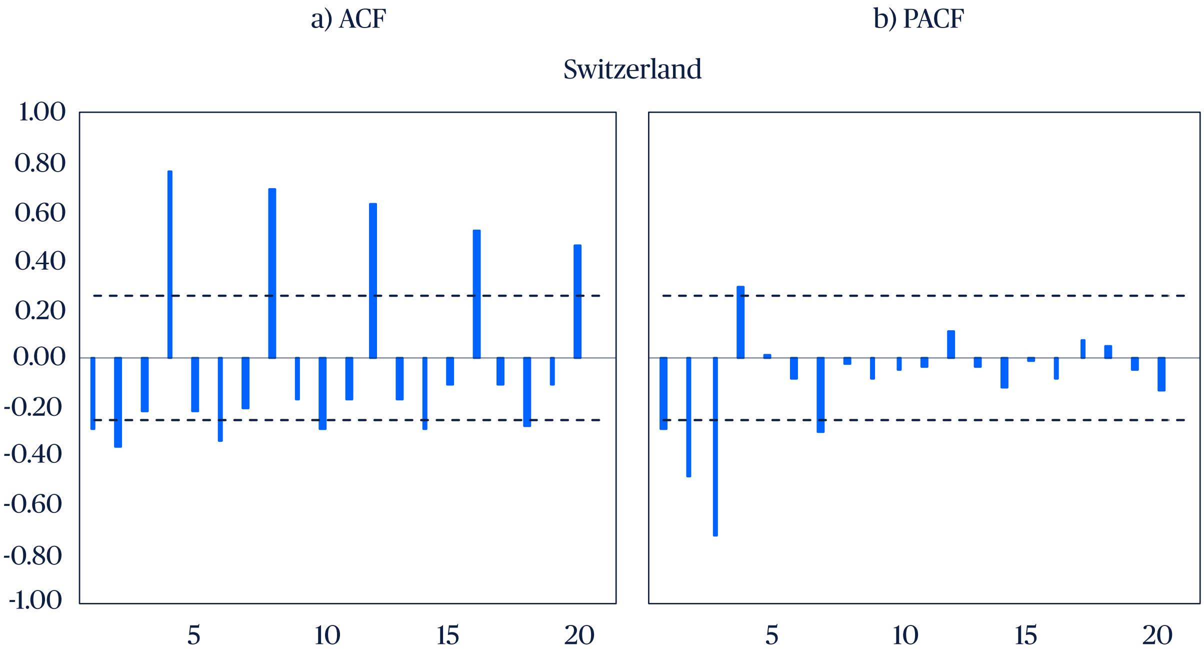
United Kingdom



a) ACF b) PACF

Italy




a) ACF
b) PACF
Switzerland
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
5
10
15
20
5
10
15
20